Translation

DE 101 48 191.8

28 September 2001

SPINNERET

The invention relates to a spinneret for melt spinning a plurality of strandlike filaments, as defined in the preamble of claim 1.

A spinneret of the described type is disclosed, for example, in DE 199 32 852 A1.

The known spinneret comprises a housing, which is used to accommodate a spinneret plate, an apertured plate, a filter insert, as well as an inlet component. The spinneret plate, the apertured plate, and the inlet component are inserted into the housing, and held inside the housing by a screwing means. The internal parts of the housing are made of a material, which has a higher coefficient of thermal expansion than the housing material. With that, it is accomplished that in the operating state of the spinneret, which could be, for example, in an area of 300°C, the internal parts expand inside the housing to a greater extent than the housing surrounding the internal parts. This causes a force of pressure to develop, which results in sealing the separating lines between the internal parts or between the internal parts and the housing.

However, the known spinneret has the disadvantage that it always requires the use of different materials for making housing components and internal housing parts of the spinneret. Furthermore, the selection of the materials for the internal parts also requires taking into account an adequate strength

and resistance to the polymer melt that is to be carried. With that, only materials are considered, which have a small difference in the thermal expansion coefficients. In this respect, the known spinneret is suited only for very high operating temperatures to generate an adequate sealing effect.

DE 199 35 982 A1 likewise discloses a spinneret, wherein a housing accommodates a filter insert and a spinneret plate. In this spinneret, the spinneret plate is held in the housing by way of a screw thread. Likewise in this instance, the internal parts are made of materials, which have a greater thermal expansion coefficient than the housing. In this respect, the foregoing disadvantages occur in the same way. In addition, the assembled situation requires that the greater thermal expansion of the internal parts relative the housing requires building up both radially active and axially active forces of pressure.

DD 125421 discloses a spinneret, wherein the spinneret plate and an apertured plate are arranged inside a sleeve, which is mounted by a screwing means to the face end of a housing portion that forms the melt inlet. Between the face end of the housing portion and the attached apertured plate and spinneret plate, a seal is arranged within the sleeve that accommodates the internal parts. The sleeve is made of a material, which has a higher thermal expansion coefficient relative to the housing component and the screwing means for purposes of achieving during the heating of the sleeve, a deformation of the seal arranged between the parts, and with that a self-sealing. This known spinneret has the disadvantage that the internal parts of the spinneret are inserted

directly into a housing component that expands to a greater extent. While taking into account the thermal expansion, it is therefore necessary to insert the internal parts with corresponding plays, which has, however, a negative effect on the required accurate fit for sealing the separating lines.

It is an object of the invention to further develop a standard spinneret of the initially described type in such a manner that the internal parts that are combined with an accurate fit inside a housing, are held in a self-sealing manner substantially independently of their materials.

According to the invention, this object is accomplished in that at least one expansion body is arranged between the housing and one of the internal parts, and that the expansion body is formed of a material, which has a higher thermal expansion coefficient in comparison with the housing material, and which generates, while being heated, inside the housing a force of pressure for bracing the spinneret plate and the inlet component in a self-sealing manner.

The invention distinguishes itself in that both the housing of the spinneret and the internal parts of the housing may be made of materials, which must exclusively satisfy the requirements of advancing a melt as well as extruding the melt, such as, for example, strength and resistance. The force of pressure necessary for a self-sealing is exclusively effected by the expansion body, when being heated. The housing and the internal parts as well as the inlet component and the spinneret plate may be made both of an identical material and of different materials.

To ensure that a bias of the internal parts inside the housing, which adjusts by the use of the

screwing means after the assembly, remains unchanged or is operative on the internal parts being sealed, together with the force of pressure that is additionally generated by the heating of the expansion body, it is preferred to construct the spinneret of the invention such that the heating permits generating a force of pressure that is largely effective in a clamping direction, which is defined by the screwing means.

In this process, it is possible to improve the effect of generating a directed force of pressure in that the expansion body and/or the material of the expansion body have a structure, which causes the expansion body to expand, when being heated, substantially in one direction. In the case of an expansion body, this may be realized, for example, by corresponding length/width ratios.

With the use of round spinnerets, wherein the circular spinneret plates are inserted inside a cylindrical housing, it is preferred according to an advantageous further development of the invention to make the expansion body as an expansion ring. In this case, the expansion ring is arranged between a cover of the housing or a bottom of the housing and the inlet component.

With the use of rectangular spinnerets, the expansion body may also be formed with advantage by a plurality of expansion pieces, which are arranged between the inlet component and a cover of the housing or a bottom of the housing.

Irrespective of the shape of the expansion body, a preferred further development of the invention proposes to associate the expansion body with a pressure plate, which forms a contact surface toward

the housing or the inlet component. With that, a surface load is advantageously generated and, thus, a force of pressure that is uniformly effective over the entire length of the separating lines.

To facilitate assembly and disassembly, in particular also with respect to possible cleaning operations, it is possible to join the expansion body permanently to either the housing or the inlet component.

To improve the self-sealing effect, for example, at operating temperatures below 200°C, one may increase the forces of pressure in that according to a particularly advantageous further development of the invention, the housing is made of a material, which has a lower thermal expansion coefficient in comparison with the materials of the internal parts -- such as, for example, the inlet component and the spinneret plate. Thus, in addition to the expansion body, the greater expansion of the internal parts inside the housing would generate forces of pressure relative the housing.

To accomplish in spinnerets of this type a uniform extrusion of the polymer melt through all spin holes of the spinneret plate, the housing additionally accommodates a filter insert and an apertured plate between the inlet component and the spinneret plate. In this case, the screwing means holds the inlet component, the filter insert, the apertured plate, and the spinneret plate inside the housing. To increase the sealing effect, it is preferred to insert seals into the separating lines.

In the operation of the spinnerets, it is possible to reach during the extrusion of the polymer melt, pressures and temperatures, which possibly cause

an overload of the internal parts inside the housing, or an overload of the housing parts or the screwing means. According to an advantageous further development of the invention, a spring extends between the housing and one of the internal parts, which serves to protect against fracture. In this connection, a spring travel is adjusted between the internal parts and the housing, so that uncontrolled expansions can be reliably absorbed.

The spinneret of the invention distinguishes itself in particular in that the expansion body has only the function of building a force of pressure by heating. The functions performed by the spinneret for melt spinning filaments are not relevant for the expansion body, so that the selection of the material for the expansion body can be directed solely to the importance of the thermal expansion. Suited to this end are in particular metals and metal alloys, such as, for example, copper. To ensure that even during cleaning operations, a basic strength of the expansion bodies remains intact, it is preferred to use such metals and metal alloys, whose melting-on temperature is above 500°C.

In the following, the invention is described with reference to some embodiments shown in the attached Figures, in which:

Figure 1 is a schematic sectional view of a first embodiment of a spinneret according to the invention;

Figure 2 is a schematic sectional view of a further embodiment of a spinneret according to the invention;

Figure 3 is a schematic top view of the embodiment of Figure 2.

Figure 1 is a sectional view of a first embodiment of a spinneret according to the invention. The spinneret possesses a cylindrical housing **1**, which is bounded toward an upper side at its face end by a bottom **6**. The bottom **6** has an opening **13** in its center. Through the opening **13** in the housing bottom **6**, an extension **20** of inlet component **2** extends, which is inserted into the housing **1**. Between the inlet component **2** and the housing bottom **6**, an expansion body **8** is arranged in the form of an expansion ring.

The inlet component **2** supports itself, via the annular expansion body **8** on the housing bottom **6**. In its extension **20** outside of the housing **1**, the inlet component **2** includes a melt inlet **5**, which connects via an inlet channel **14** and a melt channel **26** to a distributor chamber **15** inside the inlet component **2**. The face end of inlet component **2** inside the housing **1** connects to a filter insert **9**, an apertured plate **10**, and a spinneret plate **3**. Between the spinneret plate **3** and the apertured plate **10**, an external, circumferential seal **11** is provided. A circumferential seal **29** likewise surrounds the filter insert **9** that is provided in the form of a sieve plate. The seal **29** extends between the apertured plate **10** and the inlet component **2**. The spinneret plate **3** supports itself via a spring insert **27** on a collar **12** of a screwing means **7**. Between the underside of the spinneret plate **3** and the collar **12**, a gap **28** is formed, which is a measure for the travel of the spring insert **27**. The spring insert **27** could be formed by an annular spring or a plurality of springs. The screwing means **7** is constructed as a spigot nut, which engages a screw thread **21** on the circumference of the housing **1**. The spinneret plate **3** is downward open, so that spin holes

4 provided within the spinneret plate 3, form a melt outlet.

To assemble the spinneret shown in Figure 1, one begins with placing the housing 1 with its bottom 6 downward into a mounting device. Subsequently, one inserts into the housing 1, one after the other, the annular expansion body 8, the inlet component 2, the filter insert 9, the apertured plate 10, and the spinneret plate 3 with spring insert 27, as well as the associated seals 11 and 29. Finally, one applies the screwing means 7 to the screw thread 21 of the housing 1. In so doing, the internal parts inserted into the housing 1 are biased relative one another. Before inserting the spinneret into a spin beam, it is first heated in an oven to a temperature from about 200°C to 250°C. As a result of using different materials and by the action of heat, the expansion body 8, which is made, for example, of copper or a copper alloy, will expand to a greater extent than the housing 1, which is made, for example, of steel. The expansion body 8 largely expands in the direction of the apertured plate 10 and spinneret plate 3, so that a force of pressure acting in the same direction is generated in addition to the biasing force. As a result, a self-sealing action is realized in the separating lines between the inlet component 2, apertured plate 9, and spinneret plate 3. The use of the seals 11 and 29 in the separating lines of the individual parts ensures an adequate outward sealing even in critical spinning startup phases. The sealing effect is additionally increased, when the melt pressure is fully operative.

During the operation of the spinneret according to the invention, a polymer melt advances through the melt inlet 5 of the spinneret, and enters

the distributor chamber **15** through inlet channel **14** and melt channel **26**. From the distributor chamber **15**, the polymer melt passes through filter insert **9** and apertured plate **10**. Subsequently, the polymer melt is extruded through the spin holes **4** of spinneret plate **3** to a plurality of strandlike filaments. Inside the distributor chamber **15**, melt pressures as high as 250 bars are reached. To filter the polymer melt, it is preferred to form the filter insert **9** by one of more sieves with different mesh widths. However, it is also possible to use above the apertured plate **9** a filter insert with filter granules of different grain sizes.

To generate by heating the spinneret, forces of pressure that are as high as possible, it would be possible to make the internal parts -- such as inlet component **2**, apertured plate **10**, and spinneret plate **3** -- of a material that has a higher thermal expansion coefficient than the housing **1**. Thus, it would be possible to make, for example, the housing of steel, the internal parts of stainless steel, and the expansion body likewise of stainless steel. This procedure has the advantage that the use of a stainless steel ensures resistance of the internal parts to the polymer melt.

In the embodiment shown in Figure 1, the expansion ring **8** is permanently joined to the bottom **6**. This makes it possible to remove and reinstall the melt-carrying parts in a simple manner for cleaning purposes.

In the case that the cleaning process is performed on the assembled spinneret, the material of the expansion body is to be selected such that the high cleaning temperatures of more than 500°C do not lead to any undesired change of the expansion body. Thus, the

material of the expansion body should have at least a melting-on temperature above 500°C.

To be able to absorb uncontrolled expansions within the housing **1** without any overload, the spring insert **27** extends between the screwing means **7** and the spinneret plate **3**. The gap **28** formed between the underside of the spinneret plate **3** and the collar **12** of the screwing means enables an additional expansion of the internal parts or the expansion body.

Figures 2 and 3 show a further embodiment of a spinneret according to the invention, with Figure 2 being a schematic sectional view of the spinneret, and Figure 3 a schematic top view thereof. Unless reference is made to one of the Figures, the following description will apply to both Figures.

Components having the same function are provided with identical reference numerals. Contrary to the foregoing embodiment, the embodiment shown in Figures 2 and 3 is constructed as a rectangular spinneret. To this end, the spinneret comprises a rectangular housing **1**, which mounts on its underside a bottom **22** with an opening **23** that is needed for extruding the filaments. Arranged on the housing bottom **22**, inside the housing **1**, are a rectangular spinneret plate **3**, a seal **11**, an apertured plate **10**, a filter insert **9** with a seal **29**, as well as an inlet component **2**. In the center region of housing **1**, the inlet component **2** comprises an extension **20**, which projects from the housing **1** and forms a melt inlet **5**. To receive the expansion body **8**, which is formed by two expansion pieces **8.1** and **8.2** arranged in separated relationship, the inlet component **2** comprises two adjacent cutouts **24** and **31**, which accommodate the expansion pieces **8.1** and **8.2**. Outside of the inlet

component **2**, the expansion pieces **8.1** and **8.2** are supported on pressure plates **19** and **30** respectively. Above the pressure plates **19** and **30**, the housing **1** is closed by a cover **16**. The housing cover **16** is secured by pins **25**. Arranged in the housing cover **16** are two adjacent openings **32** and **33** with respectively one internal screw thread **21** and **34**. The screw threads **21** and **34** mesh with a screwing means **7.1** and **7.2** respectively, which act directly upon the pressure plates **19** and **30**. During the assembly, this allows to achieve a bias of the internal parts that are inserted into the housing **1**, with the screwing means **7.1** and **7.2** being uniformly screwed into the screw threads **21** and **34** of the housing cover **16**.

The selection of the materials for the expansion body **8** that is constructed as an expansion piece, the housing **1**, as well as the internal parts may be realized in accordance with the embodiment of Figure 1. Likewise, the sequence of the assembly and the heating of the spinneret for generating the forces of pressure correspond to the foregoing embodiment, so that the foregoing description is herewith incorporated by reference.

As shown in Figure 2, the embodiment of the spinnerets according to the invention includes a safety element for being able to absorb uncontrolled expansions. To this end, a spring **18** extends respectively between the screwing means **7.1** and pressure plate **19** as well as the screwing means **7.2** and the pressure plate **30**. Between the screwing means **7.1** and **7.2** and the pressure plates **19** and **30** respectively, a gap **28** is formed, which limits the acceptable travel of the springs **18**, and thus enables a maximum expansion of the internal parts.

The spinneret of the invention distinguishes itself in that the materials of the individual parts can be selected in accordance with their function. With that, there exists the possibility that each function, such as carrying the melt, building forces of pressure, or maintaining the internal pressure, can be optimally performed in a purposeful manner by a corresponding material selection. In this connection, it is important that the controlled expansion of the used materials permits realizing a self-sealing effect. At room temperature and thus, with little bias of the parts, this effect facilitates a fast and simple assembly of the spinneret. The imperviousness of the spin pack does not depend on the moments that are applied to tighten the screwing means. Consequently, the spinneret of the invention distinguishes itself by a high reliability in operation.

The construction of the illustrated embodiments of the spinneret according to the invention as well as the construction of the individual components are exemplary. The invention encompasses all spinnerets, wherein an additional expansion body braces the internal parts in a self-sealing manner inside a housing.

NOMENCLATURE

1	Housing
2	Inlet component
3	Spinneret plate
4	Spin holes
5	Melt inlet
6	Bottom
7	Screwing means
7.1-7.4	Screwing means
8	Expansion body
8.1-8.4	Expansion bodies
9	Filter insert
10	Apertured plate
11	Seal
12	Collar
13	Opening
14	Inlet channel
15	Distributor chamber
16	Cover
17	Inlet adapter
18	Spring
19	Pressure plate
20	Extension
21	Screw thread
22	Housing bottom
23	Spinneret opening
24	Cutouts
25	Pins
26	Melt channel
27	Spring insert
28	Gap
29	Seal
30	Pressure plate

31	Cutout
32	Opening
33	Opening
34	Screw thread